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AERONAUTICS IN THE AMERICAN SOCIETY

SPEECH BY

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Today we are here to discuss and assess the trends in aeronautics and aeronautical education. ~~My remarks will touch on matters that I believe should receive attention in your deliberations.~~ I propose to discuss ~~These~~ matters relating to the future roles of industry, government, and the universities in aeronautics.

America's belief in and support of aeronautics has established the United States in a position of world leadership in this field. It is a big business and is important to our country. It means jobs; it is a significant force in our economy; it is a major, positive factor in U. S. foreign trade; and it provides exceptional public transportation and military service. I believe, and I am sure you believe, that aeronautics will continue to play an important part in the future of our society.

The following facts attest to its importance to our country. In 1973, the aviation industry was responsible for producing about 12 billion dollars in military and civil hardware sales, of which about 7 billion dollars were for civil aircraft and engines. Of this, 3.8 billion dollars were in exports of transport aircraft and related equipment. This represents about a fivefold increase in civil export business in a 10 year period. Total exports of the aerospace industry, which includes both civil and military products, is expected to reach 7 billion dollars in 1974. The importance of this figure to our balance of payments is self-evident. Today U.S. designed and produced transport aircraft form about 80 percent of the world air transport fleets (excluding the Red-bloc countries). Because aviation products represent a major, positive factor in the U. S. economy and in the balance of trade, we can say that aeronautics is a "winner" -- let's keep it that way.

To further attest to the importance of aviation, ~~the~~ prime aircraft production plus ~~and~~ the airline industry employed some 700,000 people and grossed over 20 billion dollars this past year.

A measure of the airplane's importance to transportation is the fact that, domestically, aircraft provide three times the revenue passenger miles of all other public transportation modes combined. The near-term growth of civil demand for air transportation has been estimated at about 6 percent per year. In this country alone in 1973 some 183 million people flew about 126 billion passenger miles. For 1973, air freight and mail, respectively, were assessed to be 2.4 million ton miles and 660 thousand ton miles. Projections for freight and mail show growth rates even higher than for passengers.

Throughout the world it is estimated that 480 million people flew 380 billion passenger miles in 1973 and the volume of air cargo was greater than 12 billion ton miles.

Military aviation, too, must be factored into our planning for the future. Nearly half of our foreign and domestic volume of aviation business is for military equipment. We must recognize and deal realistically with the military aviation business from national defense and from international trade considerations. Whether we like it or not, military equipment is a tool of international diplomacy, a deterrent to aggression.

Clearly, aeronautics is a real force in our society. It is surely one of the most significant areas of technological advancement in this century. It has directly and indirectly enhanced our way of life, our technical posture and the value of our goods on the international market. There is a real need to preserve our position in aeronautics.

But while the need is clear, there is also a very real danger that we will not meet this need. The danger comes from the fact that fewer and fewer young people are entering the field of aeronautics. Let me just give you one set of numbers: In 1968, 3200 students were enrolled in junior classes in aerospace engineering; in 1973 -- in the class that will be graduating next June -- there were 800.

Obviously our young people are not now challenged by a career in aeronautics. But there are challenges -- challenges which stem from the growth in demand for service, from operational, economic, and environmental factors, and from the need for judicious use of our natural resources. Social, economic, and competitive forces -- and the state-of-the art itself -- have resulted in highly optimized and very expensive aeronautical systems.

The number of man hours for design and development, the amounts of materials, the complexity of production and test combined with worldwide inflation have driven the costs of new aircraft development to very high levels. As a result, for the military there are fewer developments, and the financing of new civil aircraft developments has become very difficult. Fewer military aircraft developments

coupled with divergent military and civil system requirements have reduced the flow of military technology to the civil sector. Thus, the civil sector will have to look after its own research, technology, and development interests to a much greater degree than in the past.

These factors singly and in combination form a formidable, but I believe solvable, set of problems. I find them a great challenge. You must, too, or you would not be part of these proceedings.

Our position of leadership in aeronautics has evolved over a 50-year period through a dedicated industry/government/university partnership. The partnership is complex, involving education, research, technology, development, manufacturing, sales, operations, and service.

The changing nature of our internal and external national affairs has imposed stresses and changes in this vital partnership. An examination of the changing circumstances will help us assess how the partners (industry, government, and universities) have been affected and what we need to do to maintain aeronautics as a positive force in our society.

From an industrial standpoint, the changes are very clear. As I have noted, aircraft are more complex and costly in time, manpower, and money to develop. Because of the soundness of designs and the increased cost of replacement aircraft, current operational aircraft likely will be in service for times considerably greater than anticipated. Thus, we can expect to see derivatives of basic designs

for the near-term fu'ur is has led some people to refer to the coming decade as the "decade of the d tive."

Another change we must factor into our planning is that there will be a reduction in the number of military developments in future years. There is little reason to believe that this situation will change. The technology support that civil systems enjoyed in the 1950's and 1960's, as a result of military programs, is thus decreasing and is projected to decrease further because of costs for new developments and divergent design requirements. For example, future civil systems will have a different sensitivity to environmental factors, fuel conservation, and passenger service and safety.

An important additional consideration is foreign competition. It is becoming more intense. The Western Europeans, Russians, and others, directly supported by their respective governments, are building more and more extremely well engineered and sophisticated aircraft. We have current examples of this. There is active competition between the European A-300 wide-body transport and our wide-body transports and between foreign and U. S. aircraft for the short-haul markets. There is an extremely active and important competition between the French lightweight fighter and the lightweight fighters of the General Dynamics and Northrop Companies. Future market potential for this class of aircraft makes it a multi-billion dollar program.

Competition is not the only factor that has forced technological change in the commercial field. The slow awakening to social and economic needs has had significant impact. We must show a special awareness to environmental factors, noise and pollution. We must be concerned about the safety, use of resources and the adequacy of our service. Congestion of the airways and airports, all weather operations, collision avoidance, and crash safety are some of the specific concerns we must deal with effectively.

These factors, system complexity, high costs, financing, and competition, combined with the world's economic posture, have caused considerable economic stress within the industry -- stress that threatens the very existence of several large industrial groups. Thus, it does not appear that we will be able to rely on industry for investments from their private funds, for activity other than that associated with growth versions of products or with the development and marketing of near-term new products having low technology risk. Yet, because of competition from foreign sources and the demand for solutions to complex social and economic problems, future aeronautical systems, to be acceptable and competitive in the open market, must incorporate the products of high risk and costly technology.

It is clear that support of the research and technology critical to the future health of civil aeronautics will depend on heavier government involvement. However, the role of industry remains paramount in the design, development,

and production of civil aircraft, and promotion and operation of civil air transportation; and the design, development, and production of military aircraft.

The government's role in aeronautics has been, and I strongly believe, should continue to be the sponsorship and conduct of basic research and advanced technology programs for civil and military aviation, and the specification, development, procurement and operation of military aircraft. For civil aircraft, it is appropriate and essential that the government pursue selective significant technology to the point where the major risk for full industrial development has been reduced to some reasonable level. In addition, the government must retain the responsibility for civil air transportation policy, rules, regulation, and airway operation.

I do not foresee any change in these basic roles for industry and government. NASA will continue to play its unique role in aviation research and technology. It is committed to advancing our aeronautical state of knowledge through the provision of research and advanced technology to help us preserve a position of world leadership.

This position of leadership cannot be preserved in the face of aggressive foreign competition without advances in technology related to safety, efficiency, performance, and the environment. NASA will do its share. We will work on low-cost aircraft concepts, reducing energy requirements, reducing environmental impact; and we will continue to work on safety, aerodynamic and propulsion performance, and operations technology.

We will enhance our military support with special attention to work of value to civil aviation, and continue our support of university research with special consideration to assisting the university community in their roles of education and research in aeronautics.

More specifically, in the next five years we in NASA plan to give special attention to the following matters:

1. Engine and aircraft technology, tending to designs that conserve energy and provide effective service.

2. Technology to utilize fuels such as hydrogen, in order to reduce reliance on petroleum-based fuels.

3. The technology required to design environmentally acceptable aircraft from noise and pollution considerations.

4. Advanced avionic systems for both navigation and aircraft flight control to improve safety, comfort, and reduce congestion.

5. Low-weight, high strength, non-strategic structural materials and design methods, to reduce the demand for expensive, energy intensive short supply materials and to reduce weight and improve operating efficiencies of engines and aircraft.

6. Close cooperation, including joint programs, with the Department of Defense to enhance both our military posture and the general state of knowledge for civil applications.

NASA, through the years, has worked closely with the university community on training programs, grants for research and facilities, and contracts for research and technology. In fiscal year 1972, our university program totaled some 1,600 grants and contracts with a value of some 100 million dollars. Of this, about 200 grants and contracts, with a value of about 10 million dollars, were in aeronautics. We have been slowly increasing our support in aeronautics. This trend will continue. We propose to assess what we have done in this arena and examine ways and means to further the productivity of this core activity.

We in NASA have not stopped examining the way we do business. Two matters currently are of particular concern to us: a good insight into the future scope and direction of our aeronautical activity to help focus program decisions for the next 4 to 5 years, and an examination of the way we conduct our affairs with a view toward strengthening our university and industry relationships.

To assist us in developing our future program, we have organized a government long-range study group to evaluate the "Outlook for Aeronautics" in the 1980-2000 time period. This study group has been working with industy representatives to gain as much insight as possible into this complex question. A report will be developed which we believe will provide all of us with a thoughtful document that will assist in building our future aeronautics programs. This report should be available in the summer of 1975.

I have noted that our success in aeronautics can be traced to a strong, unique aeronautical research and technology capability that resulted from a productive industry/government/university working relationship. ~~In this past decade we have seen an erosion of this relationship particularly with the universities, and to a degree an erosion in our aeronautics posture.~~ There is an inherent danger in taking this relationship for granted. I think we all understand the inherent dangers in this situation.

We propose to pursue the matter of strengthening our relationships with the universities, industry, and other government agencies through special discussions. We have a start on the process at this conference. I invite your comments on the government's and NASA's future role in aeronautics, and on ways to strengthen NASA's relationship with all of you in industry, government, and the universities in your roundtable discussions.

The basic strength of our aeronautics activity stems from a strong science and engineering educational base. As I said earlier, the fact that university enrollments in the engineering arts and sciences have been declining is a matter of serious concern. This trend needs to be sharply reversed.

The future of aviation in this country depends on maintaining a high quality university program which will attract and educate the individuals who will be the aeronautical researchers, designers and developers of the future, and who will perform the high-level basic research that forms the very foundation of our complex aeronautical technology. This is vital to the future health of our aeronautics

activity. Government and industry cannot move forward without good people. This job rests on the shoulders of all of us -- the university community, government, and industry. Success will help ensure that aviation remains a vital productive part of our economy and society.

To be successful in bringing the right kinds and numbers of bright, imaginative, productive young people into the field, we must communicate to the new student that there is work to be done of social and economic significance which can impact in a positive way our quality of life; that the work is challenging and rewarding; that there are jobs and a future in the broad field of aeronautics; and that special talents are needed to sustain our position of world leadership in aeronautics. Clearly, the first step is to establish credible goals and to convince the prospective student that these goals are worth the investment of their time and the dedication of their lives.

Let me propose one such goal: to provide the technology needed to produce aircraft fuel savings of 50% within the next 20 years. Since jet fuel today amounts to 8% of the United States petroleum consumption, and will amount to 12-15% by 1985, a 50% reduction in aviation fuel usage is a most worthy objective.

I am convinced that the goal can be reached. It will require work on advanced materials and composite structures to reduce weight; on avionic systems such as fly-by-wire and active controls for further weight reductions; on "super-critical" aerodynamics and boundary layer control to reduce drag; on advanced

engine cycles to reduce fuel consumption; and on operational techniques to reduce air traffic delays.

NASA today is working in all of these areas, and many more. We are working on airfoils and wing fuselage combinations that will significantly increase the efficiency of aircraft; on new aircraft concepts for improved high density short-haul transportation; on quieter, cleaner more efficient engines; on new kinds of fuels and engines so that we may not have to depend on hydrocarbon based fuels; on new materials and structural concepts for more efficient design; and, of course, on the technology that will support the development of practical supersonic air transportation.

A combination of talents and capabilities in the field of research, technology, engineering, marketing, and finance to remain competitive in aeronautics will continue to be necessary. But, of fundamental importance is the need for a sound research and technology base. Without the new young people, the better ideas, and the better designs and techniques for implementation and production, we will not be able to remain successful in ~~the race.~~ competing with other countries.

In summary then I believe that we have challenging times ahead. We have and will experience in the future intensified competition from overseas. Military programs can be expected to reduce in number and in their technical contribution to civil aviation. In large part, civil aviation will be expected to support its own research and technology needs. But its ability to borrow or attract needed

capital will prove difficult. Therefore, an aggressive government research and technology program is important to the continued health of our aeronautical activity. NASA is prepared to make an important contribution in this direction.

There are many problems to be solved today. They are not easy of solution and the problems we see for future developments are even more difficult. The improved service and growth of aviation depends on solution to these problems. I am confident that the problems will be solved by application of energy, intellect, and adequate support. An integral part of the resolution of these problems and preservation of a dominant role in aeronautics is the strengthening of our institutional relationships, and the revitalization of our educational base. More than ever before, the role of the university is important.

Key to the structuring of a proper aeronautics program is the astute delineation of future aeronautical goals and program objectives and plans. NASA or, for that matter, the government cannot do all of this alone. Proper action will require working partnerships with industry and the university community. We in NASA are dedicated to aeronautics -- to finding better ways to do our part of the job. NASA is prepared to support a stronger aeronautics research and technology effort. We need your help in maintaining the required strong posture for aeronautics. We are convinced that firm action is required, that we have the tools for the job, and that the redefinition of the tasks and ways for their accomplishment can start here. We ask you to join us in this important job.

Collectively, we need to maintain our aeronautics superiority in the face of difficult challenges. This requires renewed dedication.

We need to strengthen our industry/government/university relationship and seek better ways to maintain our nation's vigor in aeronautics.

We need to define and articulate the challenges and importance of aeronautics to the youth of the country. Through proper and adequate communication and support, we can reprime the intellectual source of the strength of our programs -- the college graduate.

For NASA's part, we are dedicated to vigorous pursuit of these objectives and will work diligently with our partners in industry, with the other government agencies, and with the university community to achieve success.